छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI MAHRAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

For

Metric No. – 1.1.1

Programme Outcomes & Course Outcomes

Under the

Criteria - I

(Curriculum Design and Development)

Key Indicator - 1.1

In

Metric No. – 1.1.1

B. Tech. (Materials Science & Metallurgical Engineering)

Co-ordinator
Internal Quality Assurance Cell
CSJM University, Kanpur

(Registrar)
C.S.J.M.University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY

KANPUR

SYLLABUS

(B.Tech.)

MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

Vision

To achieve excellence in engineering education, empower students to be technically competent professionals and entrepreneurs with strong ethical values so as to significantly contribute as agents for universal development and societal transformation

Mission

To provide affordable quality education at par with global standards of academia and serve society with harmonious social diversity

To encourage new ideas and inculcate an entrepreneurial attitude amongst the students, and provide a robust research ecosystem

To practice and encourage high standards of professional ethics and accountability among students

Bachelor of Technology in Materials Science and Metallurgical Engineering

Program Outcomes (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles mathematics, natural sciences and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations of national development.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable local development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings of national need
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions as per global development need.

PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments of regional development
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context to technological change.

Program Specific Outcomes (PSOs)

PSO-1	Students can opt career as Scientist/Metallurgist globally.
PSO-2	Providing a platform to the undergraduate students to interact with scientists and engineers of national and international repute by deputing them to industrial and R&D centers of excellence for carrying out their Project work.
PSO-3	Able to apply the engineering knowledge to suit the present-day requirements of local, national industries and academia.
PSO-4	Professionally empowering the student as technical manpower in the industry or as an entrepreneur for production analytics and innovations for national development.
PSO-5	To impart science-based engineering education to develop professional skills that will prepare the students for immediate employment in the Metallurgical and Materials branch of engineering in industry global development need.

Program Educational Outcomes (PEOs)

1. Graduate will have applied their materials development skills and knowledge of foundation principles to the design and implementation of practical systems of global development.
2. Graduates will be successfully employed in the core field of Metallurgical and Materials industry and will be actively engaged in learning, understanding and applying new ideas and technologies as the field evolves in national development.
3. To develop the design capability among students so that they have the ability to participate in creative, synthetic and integrative activities in the field of Metallurgical and Materials Engineering local or regional level.

4. To develop a global view among students so that they can appreciate diversity in the world and in intellectual pursuits.

Curricular Components

Category of courses	Credits offered
Basic Science Core	**27**
Engineering Science Core	**28**
Humanities and Social Science Core	**16**
Departmental Core	**98**
Departmental Electives	**08**
Open Electives	**0**
Projects and Seminars	**14**
Total	**191**

Semester-wise Course Structure

1st Year – Semester 1

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HSS-S101	Professional Communication	3	0	0	4
2.	MTH-S101	Mathematics-I	3	1	0	4
3.	PHY-S101	Physics-I	3	1	3	5
4.	TCA-S102	Workshop Concepts &Practice	1	1	6	5
5.	ISC-S101	Programming & Computing	3	0	3	5
6.	UHV-S101	Universal Human Values –I (SIP)				
		Total	**15**	**3**	**12**	**24**

1st Year – Semester 1I

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MTH-S102	Mathematics-II	3	1	0	4
2.	PHY-S102	Physics-II	3	1	3	5
3.	CHM-S101	Chemistry-I	3	1	3	5
4.	ESC-S101	Basic Electrical & Electronics Engg.	3	1	3	5
5.	TCA-S101	Engineering Drawing	2	1	3	5
		Total	**14**	**5**	**12**	**24**

2nd Year – Semester II1

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MTH-S201	Mathematics-III	3	1	0	4
2.	ESC-S201	Engineering Mechanics	3	1	0	4
3.	ESC – S203	Physics of Materials	3	1	0	4
4.	MSE – S201	Thermodynamics and Kinetics of Materials	3	1	0	4
5.	MSE – 202T	Nature and Properties of Materials	3	1	0	4
6.	MSE – 202P	Nature and Properties of Materials lab	0	0	2	2
7.	EVS – S101	Environmental Science	2	0	0	2
8.	SST-S201	Summer Internship	0	0	0	2
		Total	**20**	**5**	**3**	**26**

2nd Year – Semester IV

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HSS – S201	Industrial Management	3	1	0	4
2.	MSE – 203T	Phase Equilibria in Materials	3	1	0	4
3.	MSE – 203P	Phase Equilibria in Materials Lab	4	0	0	4
4.	MSE – S204	Mechanical Behaviour of Materials	3	1	0	4
5.	MSE – 205T	Materials Characterization I	3	0	0	4
6.	MSE – 205P	Materials Characterization Lab I	0	0	2	2
7.	MSE – S206	Iron and Steel Making	3	1	0	4
		Total	**19**	**4**	**2**	**26**

3rd Year – Semester V

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MSE – S301	Fundamentals of Materials	3	1	0	4
2.	MSE – S302	Manufacturing Processes:	3	1	0	4
3.	MSE – S303	Electronic and Optical Materials	3	1	0	4
4.	MSE – S304T	Phase Transformation in Metals	3	1	0	4
5.	MSE – S304P	Phase Transformation in Metals Lab	0	0	2	2
6.	MSE – S305	Heat Treatment of Metals	3	1	0	4
7.	SST-S301	Summer Internship	0	0	2	2
		Total	**15**	**5**	**4**	**24**

3rd Year – Semester VI

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MSE-S306	Principles of Metal Extraction and Refining	3	1	0	4
2.	MSE-S307T	Principles of Powder Processing	3	1	0	4
3.	MSE-S307P	Principles of Powder Processing Lab	0	0	2	2
4.	MSE-S308	Diffusion in Solids	3	1	0	4
5.	MSE-S309	Corrosion and Degradation of Materials	3	1	0	4
6.	MSE-S310	Materials Characterization – II	3	1	0	4
7.	HSS-S301	Professional Communication	3	1	0	4
6.	SSM-S301	Student Seminar	0	0	2	2
		Total	**18**	**6**	**4**	**30**

4th Year – Semester VII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HSS – S401	Industrial Economics	4	0	0	4
2.	MSE – S401	Composite Materials	3	1	0	4
3.	MSE – S402	Fuel, Refractories and Furnaces	3	1	0	4
4.	SST-S401	Summer Training	0	0	2	2
5.	MSE-S505	Elective -I	3	1	0	4
6.	PRT-S401	Project -I	0	0	6	4
		Total	**13**	**3**	**8**	**22**

4th Year - Semester VIII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MSE – S404	Electronic Materials for Industry	4	0	0	4
2.	MSE – S405	Heat and Mass Transfer	3	1	0	4
3.	MSE – S406	Computing Methods	3	1	0	4
4.	MSE – S407	Elective – II	3	1	0	4
5.	PRT-S402	Project -II	0	0	6	4
		Total	**13**	**3**	**6**	**20**

Total Credits – 191

Detailed Syllabus

Course Code: HSS-S101 **Breakup: 3 –0 – 0 – 4**
Course Name: Professional Communication

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Enhance their communication skills for tackling the professional challenges of a diverse workplace
CO2	Learn effective writing skills and be able to write clear technical reports
CO3	Improve their verbal and non-verbal communication
CO4	Be fluent orally in the use of the nuances of the English language
CO5	Learn good interpersonal skills and be proficient with the soft skills required for national and global placements

Course Details:

Unit -1 Basics of Technical Communication

Technical Communication**:** features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; Flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group); Importance of technical communication; Barriers to Communication.

Unit - II Constituents of Technical Written Communication

Words and Phrases: Word formation. Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; Requisites of Sentence Construction: Paragraph Development: Techniques and Methods - Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation-various steps.

Unit - III Forms of Technical Communication
Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Job application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports; Technical Proposal; Parts; Types; Writing of Proposal; Significance; Technical Paper, Project. Dissertation and Thesis Writing: Features, Methods & Writing.

Unit - IV Presentation Strategies

Defining Purpose; Audience & Locale; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Space; Setting Nuances of Voice Dynamics; Time-Dimension.

Unit - V Value- Based Text Readings
Following essays form the suggested text book with emphasis on Mechanics of writing,
The Aims of Science and the Humanities by M.E. Prior
The Language of Literature and Science by A.Huxley
Man and Nature by J.Bronowski
The Mother of the Sciences by A.J.Bahm
Science and Survival by Barry Commoner
Humanistic and Scientific Approaches to Human Activity by Moody E. Prior

The Effect of Scientific Temper on Man by Bertrand Russell.

Text and Reference Books:

1. V.N. Arora and Laxmi Chandra, Improve Your Writing ed. Oxford Univ. Press, New Delhi
2. Meenakshi Raman & Sangeeta Sharma, Technical Communication – Principles and Practices, Oxford Univ. Press 2007, New Delhi.
3. Barun K. Mitra, Effective Technical Communication, Oxford Univ. Press, 2006, New Delhi
4. R.C. Sharma & Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill & Co. Ltd., New Delhi.
5. M.Rosen Blum, How to Build Better Vocabulary, Bloomsbury Pub. London.
6. Norman Lewis, Word Power Made Easy, W.R. Goyal Pub. & Distributors, Delhi.
7. Krishna Mohan, Developing Communication Skills Meera Banerji-Macmillan India Ltd. Delhi.
8. L.U.B. Pandey & R.P. Singh, Manual of Practical Communication, A.I.T.B.S. Publications India Ltd.; Krishan Nagar, Delhi.

Course Code: MTH-S101 **Breakup: 3 –1 – 0 – 4**
Course Name: Mathematics-I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Test the convergence & divergence of infinite series
CO2	Understand concepts of limit, continuity and differentiability of function of two variables
CO3	Find the maxima and minima of multivariable functions
CO4	Evaluate multiple integrals, concepts of beta & gamma functions
CO5	Apply the concepts of gradient, divergence and curl to formulate engineering problems

Course Details:

Unit-I
Sequences & Series: Definition, Monotonic sequences, Bounded sequences, Convergent and Divergent Sequences Infinite series, Oscillating and Geometric series and their Convergence, n^{th} Term test, Integral test, Comparison Test, Limit Comparison test, Ratio test, Root test, Alternating series, Absolute and Conditional convergence, Leibnitz test.

Unit II
Differential Calculus: Limit Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers**.**

Unit III
Integral Calculus: Review of curve tracing, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions, Dirichlet's integral; Applications of Multiple integrals such as surface area, volumes

Unit –IV
Vector Calculus: Differentiation of vectors, gradient, divergence, curl and their physical meaning; Identities involving gradient, divergence and curl Line and surface integrals Green's, Gauss and Stroke's theorem and their applications

Unit–V
Probability and Statistics: Concept of probability, random variable and distribution function: discrete and continuous, Binomial, Poisson and Normal Distributions.

Text and Reference Books:

1. C.L.Liu : Discrete Mathematics, , McGraw Hill, 2^{nd} Edition, 1985.
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India, 1985.
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975.

Course Code: PHY-S101 **Breakup: 3 –1 – 3 – 5**
Course Name: Physics-I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the behaviour of Physical bodies
CO2	Understand the basic concepts related to the motion of all the objects around us in our daily life
CO3	Gain the foundation for applications in various applied fields in science and technology
CO4	Understand the concepts of vectors, laws of motion, momentum, energy, rotational motion, central force field, gravitation, collision and special theory of relativity
CO5	Empower the students to develop the skill of organizing the theoretical knowledge and experimental observations into a coherent understanding

Course Details: (Theory)

Unit 1
Revision of vectors, vector differentiation, ordinary derivatives of vectors, space curves continuity and differentiability, partial derivatives of vectors, gradient, divergence, curl, vector differentiation and their geometrical interpretation, various coordinate systems: polar coordinate, orthogonal curvilinear coordinate system, unit vectors and tangent vectors in curvilinear systems, special orthogonal curvilinear coordinate system, cylindrical coordinate system and spherical polar coordinate systems.

Unit 2
Inertial and non-inertial frames, fictitious force, Coriolis force, Newton's laws of motion and its applications, friction, conservative and non-conservative force, work energy theorem, conservation of linear momentum and energy, variable mass system (Rocket motion), simple harmonic motion, small oscillation, equilibrium, condition for stability of equilibrium, energy diagram, small oscillation in a bound system, working of Teetertoy.

Unit 3
Concept of centre of mass and calculation of center of mass for different objects, system of particles and collision, conditions for elastic and inelastic collision, collision in center of mass frame, rigid body kinematics, rotational motion, moment of inertia, theorems on moment of inertia, calculation of moment of inertia of bodies of different shapes.

Unit 4
Central force field, properties of central force field, inverse square law force, gravitational field and potential; Kepler's laws of planetary motion and its application
Wave mechanics, wave particle duality, De-Broglie matter wave, Schrodinger wave equations (time dependent and time independent), uncertainty principle and its applications

Unit 5
Frame of reference, Galilean transformation, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, Length contraction, time dilation, velocity addition theorem, variation of mass with velocity, Einstein's mass energy relation, relativistic relation between energy and momentum, rest mass of photon.

Text and Reference Books:

1. Vector Analysis by M. R. Spiegel, Schaum's Outlines, 2021
2. Introduction to Mechanics: R. D. Kleppner and J. Kolenkow, Cambridge

University Press, 2nd edition, 2014
3. A textbook of Mechanics by J. C. Upadhyay,Ram Prasas Publications; 1st edition, 2017
4. Mechanics by D. S. Mathur, S. Chand; New edition, 2000
5. Theory & Problems of Theoretical Mechanics by M. R. Spiegel, Schaum's Outline Series, 2017
6. Introduction to Special Theory of Relativity by Robert Resnick, Wiley, 1st edition 2007.
7. Concept of physics (Part-I) by H. C. Verma, Bharti Bhawan Publisher, 2022.
8. Quantum Mechanics by L.I. Schiff, McGraw-Hill Education (India) Pvt Limited, 2017.
9. A Textbook of Quantum Mechanics by P.M. Mathews and K. Venkatesan, McGraw-Hill Education (India) Pvt Limited, 2010.
10. Introduction to Quantum Mechanics by D.J.Griffiths, 3E, Cambridge University Press, 2018.

Course outcomes (CO): At the end of the lab course, the student will be able to:

CO1	Perform basic experiments related to mechanics
CO2	Be familiar with various measuring instruments and also would learn the importance of accuracy of measurements.

Course Details: (Practical)

1. Graphical Analysis (Ref. UIET Laboratory Manual)

2. Trajectory of projectile (Ref. UIET Laboratory Manual) Apparatus Used (Trajectory Apparatus, Metal Balls, Channels, Vernier Callipers, Carbon & Graph Paper)

3. Moment of Inertia of Bicycle wheel (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Bicycle Wheel, Masses, Thread, Stopwatch, Meter Scale, Vernier Callipers)

4. Spring Oscillations (Ref. UIET Laboratory Manual) Apparatus Used (Spring Oscillation Apparatus, Stop Watch, Masses)

5. Coupled Pendulum (Ref. UIET Laboratory Manual) Apparatus Used (Coupled Pendulum Setup, Stop Watch, Scale)

6. Bifilar Suspension System (Ref. UIET Laboratory Manual) Apparatus Used (Bifilar Suspension System Setup, Stop Watch, Masses)

7. Frequency of AC Mains by Melde's Method (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Electrical Vibrator, String, Pulley, Small Pan, Weight Box & Physical Balance)

8. Kater's (Reversible) Pendulum (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Kater's Pendulum, Stop Watch)

9. Inertia Table (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Inertia Table, Stop Watch, Vernier Callipers, Split Disc, Balancing Weights, and Given Body (Disc))

10. Moment of Inertia of Flywheel (Ref. Book by J. C. Upadhyay and UIET Laboratory Manual) Apparatus used (Fly wheel, weight hanger, slotted weights, stop watch, metre scale)

Course Code: TCA – S102T **Breakup:** **1 – 1 – 0 – 2**

Course Name: Workshop Technology

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	To Study on different machine tools and their operations.
CO-2	Basic knowledge of casting processes and their applications.
CO-3	Recognize the different types metal forming process and their operations.
CO-4	Introduction to basic fabrication processes such as welding
CO-5	To study on Modern trends in manufacturing, Unconventional machining Processes and Automation

Course Details:

Historical perspectives; Classification of Manufacturing process.

Machining: Basic principles of lathe machine & operations performed on it. Basic description of machines & operations of shaper-planer, drilling, milling, grinding.Unconventional machining processes , Machine tools.

Casting processes:pattern & allowances. Moulding sands & its desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola furnace. Die-casting & its uses.

Metal forming: Basic metal forming operations & uses of such as-forging, rolling, wire& tube drawing/making & extrusion, & its products/applications, press work & die & punch assembly, cutting & forming, its application. Hot working vs Cold working. Powder metallurgy: powder metallurgy process & its applications, plastic-products manufacturing, galvanizing & electroplating.

Welding: Importance & basics concepts of welding, classification of welding processes. Gas welding, types of flames, Electric arc welding. Resistance welding. Soldering & brazing and its uses. Modern trends in manufacturing, Automation. Introduction to NC/CNC/DNC,FMS,CAD/CAM,CIM and factory of future.

Text Books and References:

1. Chapman,W A J & Arnold ,E "Workshop Technology,1972 ; vol. I,II&III" Viva Low Priced Student Edition.
2. Raghuwanshi,B S "Workshop Technology ,2015; vol. I&II" Dhanpat Rai & Sons
3. Chaudhary, Hajra "Elements of Workshop Technology, 2008 ; vol. I&II" Media Promoters & Publishers.

Course code: TCA – S102P **Breakup:** **0 – 0 – 3 – 3**

Course Name: Workshop Practice Lab

Course Details:

1. Foundry (1 turn)
2. Welding (3 turns)
   a. Gas Welding (1 turn)
   b. Arc Welding (2 turns)
      (i). Lap Joint (1 turn)
      (ii) Butt Joint (1 turn)
3. M/C Shop (4 Turns)
4. Fitting & Sheet Metal Work (1 turn+1 turn)
5. Carpentry Shop(1 turn)
6. Black-smithy shop(1 turn)

Text Books and References:

Text Books and References:

4. Chapman,W A J & Arnold ,E "Workshop Technology,1972 ; vol. I,II&III" Viva Low Priced Student Edition.
5. Raghuwanshi,B S "Workshop Technology ,2015; vol. I&II" Dhanpat Rai & Sons
6. Chaudhary, Hajra "Elements of Workshop Technology, 2008 ; vol. I&II" Media Promoters & Publishers.

Course Code: ISC – S101 **Breakup: 3 – 0 – 3 – 5**
Course Name: Programming & Computing(C & UNIX)

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Recollect various programming constructs and to develop C programs
CO2	Understand the fundamentals of C programming
CO3	Choose the right data representation formats based on the requirements of the problem
CO4	Implement different Operations on arrays, functions, pointers, structures, unions and files

Course Details:
Basic concepts of Computers, Basic UNIX Concepts and Vi - Editor
Introduction to C: Basic Programming concepts, Program structure in C, Variables and Constants, Data types, Conditional statements, control statements, Functions, Arrays, Structures, Introduction to pointers and Introduction to File Systems.

Text Books and References:

1. Programming in C, Schaum Series, 3rd edition, BPB Publication, Byron S. Gottfried
2. The 'C' Programming, Denis Ritchi, Second edition, PHI, 1988
3. Mastering C, Venugopal, Second edition, TMH, 2006
4. Let Us C, Yashavant Kanetkar, 18th Edition, BPB, 2021
5. Programming in ANSI C, Balaguruswami, Eighth Edition, TMH, 2019

Computer Programming Lab:

Learning OS Commands
Practice of all Internal and External DOS Commands, Writing simple batch programs, Exposure to Windows environment, Practice of UNIX commands and Vi editor, Writing simple shell script
C Programming:
Practicing programs to get exposure to basic data types, algebraic expressions, Conditional statements, Input Output Formatting, Control structures, arrays, functions, structures, pointers and basic file handling

Course Code: MTH-S102 **Breakup: 3 –1 – 0 – 4**
Course Name: Mathematics-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Solve the consistent system of linear equations
CO2	Determine the power series expansion of a given function
CO3	Solve arbitrary order linear differential equations with constant coefficients
CO4	Apply Laplace transforms to solve physical problems arising in engineering
CO5	Find eigen values, eigen vectors & diagonalize a matrix
CO6	Understand concept of vector space & linear transformation

Course Details:

Unit–I
Matrix Algebra: Elementary operations and their use in finding Rank, Inverse of a matrix and solution of system of linear equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties

Unit–II
Vector Space, Linear transformation, Linear dependent and linear independent, Eigen-values and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix

Unit-III
Ordinary Differential Equations of second order: Solution of linear differential equations with Constant coefficients. Euler-Cauchy equations, Solution of second order differential equations by changing dependent and independent variables; Method of variation of parameters, Introduction to series solution method, Frobenious Methods

Unit- IV
Ordinary differential equations of higher orders: Matrix method

Unit-V
Laplace Transform: Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem, Initial and final value theorem; Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function. Applications of Laplace transform.

Text and Reference Books:

1. C.L.Liu : Discrete Mathematics, , McGraw Hill, 2nd Edition, 1985.
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India, 1985.
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975.

Course Code: CHM – S101 **Breakup: 3 –1 – 3 – 5**
Course Name: Chemistry - I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concept related to atoms and molecules, chemical bonding coordinate compounds and its applications
CO2	Concept of chemical kinetics, electrochemistry, photochemistry and their applications
CO3	Understand the concept of spectroscopy and its applications in various fields
CO4	Understand the basics of stereochemistry, organic reactions and its mechanism for various types of reactions
CO5	Various experiments helps the student to learn the basics of experiments to apply in day today life as well as in industry

Course Details: (Theory)

UNIT-I - Atoms and Molecules:
Need for wave mechanical picture of atomic structure [Photoelectric effect, de Broglie concept of matter waves], Derivation of Schrodinger wave equation [as an example particle moving in uni-dimensional potential well]
Chemical Bonding - Orbital concepts in bonding, V.B. and M.O. theory, M.O. diagrams, Intermolecular interactions

UNIT-II - Reaction Dynamics:
Order, Molecularity, Rate law, Integrated rate equations, Methods of determining of order of reaction, Complex reaction kinetics- chain reactions and reversible reactions in detail, Catalysis and enzyme catalysis

UNIT-III - Electrochemistry:
Arrhenius theory of electrolytic dissociation, Transport number, Kohlrausch's law, Solubility product, Redox reaction, Electrochemical and concentration cells.

UNIT-IV- Stereochemistry:
Introduction, Chirality, Enantiomers, Diastereomers, Projection formula of a tetrahedral carbon, Geometrical isomerism, Conformers

UNIT- V- Application of Spectroscopic Techniques:
Basic working principle on measurement technique: IR, UV visible spectroscopy and NMR

UNIT-VI - Organic Reactions:
Concepts Electron displacement effects, Organic intermediates, Types of reactions [addition, elimination and substitution reactions]

UNIT-VII - Photochemistry:
Principles of photo chemistry, Photoexcitation of organic molecules, Jablonski diagram, Laws of photochemistry and quantum yield, some examples of photochemical reactions, Chemistry of vision and other applications of photochemistry

UNIT-VIII - Transition Metal Chemistry:
Structure of coordination compounds corresponding to coordination number up to 6, Types of ligands, chelation, Isomerism [geometrical, optical, ionization, linkage and coordination], Theories of bonding in coordination compounds- crystal field theory, Valence bond theory.

Recommended Books:
Physical Chemistry-

1. Physical Chemistry, P. Atkins and J De Paul, International student edition , 8th edition, Oxford University Press, (2006)
2. Principles of physical chemistry, B. R. Puri, L.R. Sharma and M.S. Pathania, Shoban Lal Nagin Chand and Co., Jalandhar, 43 edition, Vishal Publishing ***Co***. (2017)

Organic Chemistry-

1. Organic Chemistry, R. T. Morrison and R.N. Boyd, 6th edition, Prentice hall of India (P) Ltd. New Delhi (2016)
2. A Textbook of Organic Chemistry, Arun Bahl and B.S. Bahl, S., 22th edition, S.Chand Publishers, New Delhi (2019)

3.Inorganic Chemistry-

1. Concise Inorganic chemistry, J.D. Lee, 5th edition, (1997).
2. Inorganic Chemistry, J.E. Huyee, E.A. Keiter and R.L. Keiter. 4th edition, Prentice Hall, Upper Saddle River,(2017)

Engineering Chemistry-

1. Engineering chemistry , Shashi Chawala, Dhanpat Rai & Co.(2013)
2. Engineering chemistry , P. C.Jain and Monika Jain. 16th edition, Dhanpat Rai Publishing Company (2015)

Course Name: Chemistry Lab- I

Course Details: (Practical)

1. To estimate the strength of the given unknown solution of Mohr's salt (Ferrous ammonium sulphate (FeSO4.(NH4)SO4.6H2O) using KMnO4 solution as an intermediate.
2. To prepare a sample of p-nitroacetanilide.
3. To prepare a sample of Aspirin.
4. Preparation of Tris (Thiourea) Copper (I) sulphate.
5. Preparation of Hexaamine Nickel (II) chloride [Ni(NH3)6]Cl2.
6. Estimation of commercial caustic soda: Determination of the amounts of sodium carbonate and sodium hydroxide present together in the given commercial caustic soda.
7. Estimation of calcium ions present in tap water.
8. To determine the partition coefficient of acetic acid between n-butanol and water.
9. To study the photochemical reduction of a ferric salt (Blue printing).

10. To determine the viscosity of a given liquid room temperature using Ostwald's viscometer.
11. To separate Ag(I), Hg (I) and Pb(II) ions by paper chromatography and calculate their RF values.
12. Understanding reaction kinetics and calculating the rate and order of a reaction.
13. To study the kinetics of first order reaction (methyl acetate hydrolysis catalysed by o.5 N HCl solution).

Course Code: ESC-S101 **Breakup: 3 –1 – 3 – 5**
Course Name: Basic Electrical & Electronics Engineering

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Predict the behaviour of any electrical and magnetic circuits
CO2	Formulate and solve complex AC, DC circuits
CO3	Realize the requirement of transformers in transmission and distribution of electric power and other applications
CO4	Have knowledge of some basic electronic components and circuits
CO5	Understand the basics of diode and transistor circuits
CO6	Understand the working of some I C based circuits
CO7	Study logic gates and their usage in digital circuits

Course Details: (Theory)

Unit – I

Sinusoidal steady state circuit analysis, voltage, current, sinusoidal & phaser presentation single phase AC circuit – behavior of resistance, inductance & capacitance & their combination, impedance concept of power, power factor; Series & parallel resonance – band width & quality factor, Three phase circuits – phase voltage & current, line & phase quantities, phasor diagram, balanced & unbalanced loads, Measurement of R, L, and C.

Unit –II

Network Theory: Network theorems – Thevenin's, Norton, maximum power transfer theorem, star delta transformation, circuit theory concept – mesh & nodal analysis.

Unit – III

Magnetic circuit concepts: self-inductance, magnetic coupling analysis of single tuned & double tuned circuit involving mutual inductance, introduction to transformer.

Unit – IV

Basic Instruments, electrical measurement – measurement of voltage , current , power & energy, voltmeters& ammeter , wattmeter , energy meter , three phase power measurement , electronics instrument –multimeter, CRO(analog & digital),An overview of voltage regulator.

Unit – V

Introduction to basic electronics devices – junction diode, BJT, amplifier, op-amps & instrumentation amplifier with mathematical operation

Number System: Introduction to binary, octal, decimal & hexadecimal systems, representation of negative, numbers, 1's, 2's, 9's, 10's complement and their arithmetic.

Text Books

1. Edward Hughe “Electrical and Electronic Technology”, 10th Edition, Pearson Education Asia, 2019.
2. P. Kothari, I J Nagrath, “Electric Machines”, 5th Edition, Tata McGraw Hill, 2017.
3. P. Malvino, “Electronic Principles”, 7th Edition, Tata McGraw Hill, 2007.
4. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) 23Rev Ed Edition, S. Chand Publishing.2020

Reference Books

1. S. K. Bhattcharya, “Basic Electrical and Electronics Engineering”, Pearson, 2012.
2. Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice Hall of India Private Limited, 2nd Edition, 2003.
3. David Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.
4. Michael Tooley A., “Electronic circuits: Fundamentals and Applications”, 3rd Edition, Elsevier Limited, 2006.

Course Name: Basic Electrical & Electronics Engineering Lab
Course Details: (Practical)

1. Familiarization with the Electronic Instruments.

2. Familiarization with electronic components and Bread board.

3. To verify the Thevenin theorem.

4. To verify the Superposition theorem.

5. Measurement of voltage and frequency with CRO.

6. To study half wave rectifier.

7. To study full wave bridge rectifier.

8. To study full wave bridge rectifier with filter.

9. To study and verify the truth table of different logic gates using digital IC.

10. To study different type of transformer and there operation.

11. To study basic wiring and design a switchboard/extension board.

12. To study the polarity test of a single phase transformer.

13. To study the open & short circuit test of a transformer and calibration losses.

14. To study the load test and efficiency of a single phase transformer.

Course Code: PHY-S102 **Breakup: 3 –1 – 3 –5**
Course Name: Physics-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	understand the vector integration which they can apply in electricity and magnetism
CO2	Understand the concepts of wave optics such as the phenomena of interference, diffraction and polarization of light
CO3	Understand the concepts of electrostatics, magnetostatics, electromagnetic induction, Maxwell's equations and electromagnetic waves
CO4	Apply the concepts of physics in the engineering courses

Course Details: (Theory)

Unit 1
Vector integration, Stokes' theorem, divergence theorem, electrostatics: Coulomb's law, superposition of electric forces, electric flux, Gauss's law, electric field, potential, calculation of electric fields due to different charge distribution, gradient and curl of electric field, electric dipoles and multipoles, potential energy of a dipole placed in external electric field, Laplace's equation, Poisson's equation.

Unit 2
Magnetostatics, motion of charge in electric and magnetic field, Lorentz force, magnetic flux, torque on a current coil in uniform magnetic field, magnetic dipole, potential energy of a magnetic dipole, Biot-Savart law, Ampere's law, calculation of magnetic field due to different current distribution, divergence and curl of magnetic field.

Unit 3
Electromagnetic induction, Faraday's law, Lenz's law, self-induction, mutual induction, growth and decay of current in L-R circuit, electromagnetic waves, displacement current, Maxwell's equations in free space and matter, verification of Faraday's law of electromagnetic induction and Ampere's law in vacuum by using plane electromagnetic waves and derivation of velocity of light (c) in terms of permittivity and permeability of free space, Poynting vectors, Poynting theorem.

Unit 4
Coherent sources, Interference, Fresnel's biprism, interference in uniform and wedge shaped thin films, necessity of extended source, Newton's rings and its applications, Fresnel and Fraunhofer diffraction at single slit and double slits, absent spectra, diffraction grating, spectra with grating, dispersive power, resolving power of grating, Rayleigh's criterion of resolution

Unit 5
Dispersion of light, angular dispersion, dispersive power, irrational dispersion, angular and chromatic dispersion, deviation without dispersion, dispersion without deviation, polarization of light, Fresnel's theory of optical activity and polarimeter, fundamental idea of optical fiber, types of fibers.

Text and References Books:

1. Introduction to Electrodynamics by D.J. Griffiths, 3E, Prentice-Hall of India Private Limited, 2002.
2. Vector Analysis by M. R. Spiegel, Schaum's Outlines, 2021
3. Optics by Ajoy Ghatak, McGraw Hill Education (India) Private Limited, 7th Edition,2020
4. A textbook of Optics by Subrahmanyam, Brijlal and Avadhanulu, Schand; 23rd Rev. Edition. 2006.
5. Classical electrodynamics by J. D. Jackson,Wiley, 3rd edition, 1998.
6. Concept of Modern Physics by Aurthur Beiser, McGraw-Hill Education,6th Edition 2021.
7. Introduction to fiber optics by Ajoy Ghatak and K. Tyagrajan, 1E, Cambridge University Press, 2012.

Course Name: Physics Lab-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Gain practical knowledge about electricity and magnetism and measurements such as resistance, voltage, current etc
CO2	Gain experimental knowledge of interference, diffraction and polarization of light and measurement of the wavelengths of the monochromatic light with the help of Newton's ring experiment, Fresnel's biprism experiment, etc.
CO3	Understand the concept of semiconductor physics through the four probe experiment
CO4	Gain knowledge about the various optical devices: prism, grating, spectrometer.
CO5	Understand the basic concept of modern physics through the determination of Planck's constant

Course Details: (Practical)

1. Newton's Ring (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Traveling Microscope, Support for Glass Plate inclined at 450 to the Vertical, Short Focus Convex Lens, Sodium Lamp, Plano Convex Lens, An Optically Plane Glass Plate)
2. Prism Spectrometer (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Spectrometer, Glass Prism, Reading Lens, Mercury Lamp)
3. Plane Transmission Grating (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Spectrometer, Diffraction Grating, Mercury Lamp)
4. Ballistic Galvanometer (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Ballistic Galvanometer, Morse key, Damping key, Condenser, Rheostat, Volt Meter, Storage Battery, Connection Wires)
5. Carey Foster's Bridge (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Carey Foster's Bridge, Laclanche cell, Resistance Box, Galvanometer, Plug Key, Copper Strip)
6. Fresnel's Biprism (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Sodium Lamp, Biprism, Convex Lens, Optical Bench with Four Uprights)

7. Variation of Magnetic Field (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Stewart and Gee type Tangent Galvanometer, Storage Battery, Commutator, Ammeter, Rheostat, One way Plug Key, Connection Wires)
8. Polarimeter (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Sodium Lamp, Polarimeter, Physical Balance)
9. Planck's Constant (Ref. Book by S.K. Gupta and UIET Laboratory Manual) Apparatus Used (Power supply, photocell, connecting wires)
10. Energy Band Gap by Four Probe Method (Ref. Book by S.K. Gupta and UIET Laboratory Manual) Apparatus Used (An experimental kit)

Course Code: TCA-S101 **Breakup: 0 –2 – 3 – 5**

Course Name: Engineering Drawing

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basics of engineering graphics
CO2	Develop skills to prepare basic engineering drawings
CO3	Understand the concept of projection and acquire visualization skills
CO4	Gain imaginative skills to understand section of solids and developments of surfaces

Course Details:

Introduction- Drawing instruments and their uses, BIS conventions, lettering dimensioning and free hand practicing.

Orthographic projections: Lines, planes and surfaces of objects, Sectional views, Auxiliary views, Space geometry: lines and planes, True lengths and shapes, Properties of parallelism, Perpendicularity and intersections of lines and planes, Simple intersections of solids and development of lateral simple solids**.**

Isometric Projections: Introduction , isometric scale, isometric projection of simple plane figures, isometric projection of tetrahedron, hexahedron (cube), right regular prisms , pyramids, cylinders, cones, spheres, cut spheres and combinations of solids.

Introduction to computer graphics: Some problems on above topics on computer graphics.

Text Books and References:

1. Narayana,K.L. & Kannaiah,P. "Engg.Graphics". Tata McGraw Hill, New Delhi (2012).
2. Bhatt,N.D. (2014) "Elementary Engg. Drawing" Charotar Book stall. Anand.
3. Lakshminarayanan ,V and Vaish Wannar , R. S. "Engg.Graphics".Jain Brothers , New Delhi (2006).
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
5. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
6. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

Course Code: MTH-S201 **Breakup: 3 –1 – 0 – 4**
Course Name: Mathematics - III

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Obtain the Fourier series expansion of a given function
CO2	Apply Fourier transform for solving Boundary Value Problems
CO3	Determine the solution of linear partial differential equations (PDE) by variable Lagrange's method & some nonlinear PDEs
CO4	Understand and use of complex variable & analyticity
CO5	Expand a function of Laurent series
CO6	Evaluation of real integrals using residues

Course Details

Unit – I
Function of a Complex variable: Complex numbers- power and roots, limits, continuity and derivative of functions of complex variable, Analytic functions, Cauchy - Reimann equations, Harmonic function, Harmonic conjugate of analytic function and methods of finding it, Complex Exponential, Trigonometric, Hyperbolic and Logarithm function.

Unit – II
Complex Integration: Line integral in complex plane(definite and indefinite), Cauchy's Integral theorem, Cauchy's Integral formula, Derivatives of analytic functions, Cauchy's Inequality, Liouville's theorem, Morera's theorem, Power series representation of analytic function and radius of convergence, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals, Improper Integrals of rational functions.

Unit-III
Fourier series: Trigonometric Fourier series and its convergence. Fourier series of even and odd functions, Fourier half-range series; Parseval`s identity, Complex form of Fourier series;

Unit-IV
Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms and their elementary properties, Convolution theorem, Application of Fourier transforms to BVP

Unit-V
Partial Differential Equations: Formation of first and second order partial differential equations. Solution of first order partial differential equations: Lagrange`s equation, Four standard forms of non-linear first order equations.

Text and Reference Books:

1. C.L.Liu : Discrete Mathematics, , McGraw Hill, 2nd Edition, 1985.
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India, 1985.
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975.

Course Code: ESC-S201 **Breakup: 3 – 1 – 0 – 4**

Course Name: Engineering Mechanics

Course outcomes (CO): At the end of the course, the student will be able to:

CO-1	Determine the resultant force and moment for a given system of forces
CO-2	Determine the Centre of Gravity and Moment of Inertia of surfaces and solids
CO-3	Determine the shear force, Bending moment of beams and analyze the trusses and problems related to frictions
CO-4	Determine the stresses in beam for pure bending and effect of torsion in shafts
CO-5	Calculate the motion characteristics of a body subjected to a given force system

Course Details:

General Coplanar force systems : Basis concepts, Law of motions, principle of transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, simplest resultant of two dimensional concurrent & non concurrent force systems, free body diagrams, equilibrium & its equations, applications.

Trusses & Cables : Introductions, simple truss & solutions of simple truss, method of joints & method of sections.

Friction : Introductin , Laws of coulomb friction, equilibrium of bodies involving dry friction, belt friction, applications.

Centre of gravity , centroid, Moment of Inertia : Centroid of plane, curve, area ,volume & composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principal moment inertia, mass moment of inertia of circular ring, disc, cylinder, sphere and cone about their axis of symmetry.

Beams: Introductions, shear force and bending moment, differential equations for equilibrium, shear force & bending moments diagrams for statically determinate beams.
Kinematics of rigid body: Introduction, plane motion of rigid bodies, velocity & acceleration under translation & rotational motion, Relative velocity, projectile motion.

Kinetics of rigid bodies: Introduction, force, mass & acceleration, work & energy, impulse & momentum, D'Alembert principles & dynamic equilibrium. Virtual work.

Text Books and Reference :

1. Beer F.P. & Johnston ,F.R. " Mechanics For Engineers" 11th edition 2017, McGraw Hill.
2. Shames, I.H. " Engg. Mechanics" 4th edition2005 , P H I.
3. Meriam , J. L. " Statics" 7th edition 2011, J. Wiley.
4. Meriam , J. L. " Dynamics" 7th edition 2011, J. Wiley.

Course Code: ESC – S203 **Breakup: 3 –1 – 0 – 4**

Course Name: Physics of Materials

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Describe the mechanical, electrical, thermal and optical properties of materials;
CO2	Analyse the importance of material properties for a wide variety of engineering situations;
CO3	Evaluate and select suitable materials for different practical applications;
CO4	Recall typical values of the properties of common practical materials;
CO5	Understand the micro-physics and chemistry responsible for material properties, and analyse how they can be modified.

Course Details

Failure of classical physics, black body radiation, Planck postulate, early experiments exhibiting quantum effects, Photoelectric effect, Davisson-Garmcr results, Compton shift, Pair production, Wave particle duality, de-Broglie postulate and Einstein relation, Wave description & localization, Uncertainty principle, probability density, expectation value, energy & momentum operations, Schroedinger equation, Solution for step, Barrier & well potentials, Periodic well potentials, Block Functions, Kronig-penny model, Energy hands in metals & semiconductors, Brillouin zones, Bravais lattices & crystal Structure. Miller indices of crystal direction & planes, crystal symmetry, reciprocal space lattices. Lave equation & Bragg relation, Block waves & diffraction.

Text Books and Reference:

1. The Science and Engineering of Materials, Donald R. Askeland (Chapman & Hall), 2010
2. Materials Science and Engineering, V. Raghvan, 2004, PHI

Course Code: MSE-S201 **Breakup: 3 – 1 – 0 – 4**

Course Name: Thermodynamics and Kinetics of Materials

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding of thermodynamic laws applicable globally
CO2	Knowledge of mixture, solution, chemical and electrical deriving forces
CO3	Thermodynamic processes and their use on materials and metallurgical aspects
CO4	Analysis of chemical and electrical deriving forces
CO5	Understanding of thermodynamics of point defects

Course Details

Heterogeneous & homogeneous systems, Extensive & intensive properties, Simple equilibrium. First law of thermodynamics, constant volume & constant pressure processes, Spontaneous process, Entropy quantification of irreversibility, Properties of heat engines, Second law of thermodynamics, Criterion for equilibrium, Entropy & disorder, most probable microstate. configurationally entropy & thermal entropy, Auxiliary functions, Maxwell's relations, Gibbs Helmholtz equation, Third law of thermodynamics, Variation of Gibbs energy with temperature & pressure, Clausius-Clapeyron equation, Thermodynamic properties of mixtures of ideal & imperfect gases, Ellingham diagrams, Raoults & Henry's laws, activity of a component, Gibbs — Duhem equation, Non-ideal solutions, Regular solutions, Quasi-chemical model of solution, activity & alternative standard states, Gibbs phase rule, Binary systems involving compound formation, Solubility of gases in metals, Formation of oxide phases of variable composition, relation between chemical & electrical driving forces, Nernst equation, Thermodynamics of point defects.

Text Books and Reference:

1. Introduction to Thermodynamics, Y. V. C. Rao, 2001, New Age
2. Textbook of Materials and Metallurgical Thermodynamics, A. Ghosh (PHI), 2009

Course Code: **MSE-S202T** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Nature and Properties of Materials**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding about the crystal structure and the bonding concept and also the existing defects in the crystals
CO2	Understanding about the thermal, magnetic and electrical properties
CO3	Understanding about the Bonding Concepts
CO4	Understanding about the the existing defects in the crystals
CO5	Understanding about the thermal properties

Course Details:

Atomic structure & bonding in solids, Crystal structures, Imperfection in solids, Linear defects, Slip & plastic deformation, Planar defects, Volume defects, Volume defects, Strengthening mechanisms, Diffusion, Mechanical properties of metals, Phase diagram & phase transformation, Phase equilibria involving solid to solid reactions, Structure & properties of ceramics & polymers Corrosion & degradation of materials, Thermal properties, Magnetic properties, Electrical properties & Optical properties of materials, Material Selection, Synthesis & Design.

Text Books and Reference:

1. Materials Science and Engineering: An Introduction, W. D. Callister, (WILEY), 2006
2. Materials Science and Engineering, V. Raghvan, 2004, PHI

Course Code: **MSE-S202P** **Breakup:** **0 – 0 – 3 – 2**

Course Name: **Nature and Properties of Materials Lab**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Students will learn about various crystal structures
CO2	Students will learn how atoms coordinate in different crystal Structures

Course Details

Basic crystal structures, Crystal planes & directions, Atomic packing,
Determination of crystal structures (cubic), Mechanical testing.

Course Code: EVS-S101 **Breakup: 2 –0 – 0 – 2**

Course Name: Environmental Science
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To make students realize the importance and their role in the protection and maintenance of a healthy environment for sustainable development
CO2	To learn how the natural world works, to understand how humans interact with the environment, and to find ways to deal with environmental problems and live more sustainably.

Course Details:

UNIT-I
Scope and Importance of environmental studies, Need for public awareness, Segments of environment, biodiversities: Genetic diversity, Species diversity, Ecosystem diversity, Landscape diversity, Causes of pollution and detrimental effects.

UNIT-II
Eco systems- Types of systems, energy flow in an ecosystem, Balanced ecosystem,
Human activities- Food, shelter, economic and social security, Effects of human activities on environment- Agriculture, housing, Industry, mining and transportation activities, Basics of Environmental Impact Assessment, Sustainable Development.

UNIT-III
Types of natural resources: Water resources-Availability and quality aspects, Water borne diseases, Fluoride problems in portable water, Mineral resources, Food resources, Land resources, Forest Wealth, Material cycles- Carbon, Nitrogen and Sulphur cycle.

UNIT-IV
Energy- Different types of energy (Renewable and Non-renewable), Convectional and non- conventional energy-sources. Electromagnetic radiation, Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas, Hydrogen as an alternative future source of energy.

UNIT-V
Environmental pollution and their effects, Water pollution, Land pollution, Noise pollution, public Health aspects, Air pollution. Current environmental issues of importance and their impact on environment: Population Growth, Climate change and global warming effect, Urbanization, Automobile pollution, Acid rain, Ozone layer depletion.

UNIT-VI
Preventive measures and control of pollution, Air and Water pollution control, Sold waste management, Case studies.

UNIT-VII
Role of Government in environment protection, Legal Aspects, Initiatives and protection Acts, public awareness, Initiatives by Non-governmental Organizations (NGOs), Role of IT services, Disaster management.

UNIT-VIII
Field work/ Activities/ Visit.

Text and References Books:

1. Environmental Studies- Benny Joseph, TATA Mcgaw Hill publication.

2. Environmental Studies- Dr. D.L. Manjunath, pearson Education.
3. Environmental Studies- R. Rajgopalan, Oxford publication.
4. Environmental Science and Technology- M. Anji Reddy, BS publication.
5. Principles of Environmental Science and Engineering- P. VenugopalanRao, Prentice Hall of India.
6. Environmental Science and Engineering- Meenakshi, Prentice Hall of India.

Course Code: **HSS-S201** **Breakup:** **3 – 0 – 0 –4**

Course Name: **Industrial Management**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concepts related to business and demonstrate the roles, skills and functions of management
CO2	Understand how the industrial company can be organized and managed
CO3	Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities
CO4	Express leadership and entrepreneurial attributes through various case studies of local regions.

Course Details

Introduction to Industrial management, Brief history of industries in India, Brief definition of management, organization and administration. Characteristics of management, Principle of management, Function of management like, planning, organization, direction, co-ordination etc.

Level of management, skills of management, inter relation between skills and levels of management, scientific management, Introduction to Schools of Management thoughts, introduction to organization, study of basic type of organization for ex. Line and staff organization, project organization, metrics organization, Informal organization, Introduction to industrial Psychology, Motivation theory and study of Maxlow, Need, Hierarchy Theory, Planned Location, Planned Layout. Study of different forms of layout like line layout, process layout, product layout, combinational layout, sixth position layout etc.

Objective of planned layout, introduction to material management, scope of material management, study of inventory control method, introduction to different types of inventory control techniques, introduction to work study, motion study etc, introduction to conflict management.

Text Book and References:

1. Khanna O.P. : Industrial Engineering
2. T.R. Banga : Industrial Engineering and Management
3. Mahajan : Industrial and Process Management

Course Code: **MSE-S203T** **Breakup:** **3 – 1 – 0 – 3**

Course Name: **Phase Equilibria in Materials**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Study of phase, equilibrium, component and degree of freedom
CO2	Study of phase rule and stability of phases
CO3	Understanding of importance of Phase Diagram concepts.
CO4	Understand basics of metallography and processes of the metallography.

Course Details

Phase rule, Lever rule & free energy of phase mixtures, Binary isomorphous system equilibrium phase rule, Lever rule & free solidification, non-equilibrium solidification, dendritic growth, coring, CuNi alloys & zone refining. Binary eutectic & hypoeutectic systems - solidification of eutectic, hypoeutectic & hypereutectic alloys. Solidification of peritectic, hypoperitectic & hyperperitectic alloys, Morphologies of eutectic systems Binary monotectic & syntectic systems, Stability of regular solution & miscibility gap, intrinsic stability of solution & spinodal, Hume-Rothery rules & intermediate phases, e.g., laves, sigma, electron compounds, binary eutectoid, peritectoid, metatectic & monotectic systems, Iron carbon phase diagram & microstructures of plain carbon steel & cast iron, Non-equilibrium structrures, Binary ceramic systems, Ternary phase diagrams Gibbs triangle isothermal & vertical sections polythermal projections, two-phase equilibrium, concept of tie-lines, rules for construction of tie-lines, three-phase equilibrium, concept of tie-triangle four-phase equlibria multi-component alloy systems stainless steels, high speed steels, Hadfield steels, super alloys, light metal alloys, refactor systems.

Text Books and Reference:

1. Physical Metallurgy, V. Raghvan (PHI), 2015
2. Materials Science and Engineering, V. Raghvan, 2004, PHI
3. Phase Diagrams in Metallurgy, Frederic N. Rhines (Mc Graw Hill), 1956
4. Introduction to Physical Metallurgy, Sidney H Avner (TMH), 1974

Course Code: **MSE-S203P** **Breakup:** **0 – 0 – 3 – 2**

Course Name: **Phase Equilibria in Materials Lab**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding of importance of Phase Diagram concepts through experiments
CO2	Understand basics of metallography and processes of the metallography through experiments

Course Details

Metallographic Sample Preparation of common metals & Observation of Microstructure.

Course Code: **MSE-S204** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Mechanical Behaviour of Materials**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding of stress, strain and their relationships, along with study of these for various materials.
CO2	Study of Fracture, Fatigue and Creep failure
CO3	Stress and strain study for various materials.
CO4	Study of Fracture and strength of materials
CO5	Study of failure of materials in regional environment.

Course Details

Stress tensor & stress transformation. equations, Principle stresses, Strain tensor & strain transformation equations, Isotropic & anisotropic elasticity, elastic strain energy, Yield criteria & constitutive relationships, work hardening, plastic instability & its significance, Crystallographic aspects of deformation, dislocation theory edge, screw & mixed dislocations, resistance to dislocation motion & elastic properties of dislocations, dislocation interactions, multiplication of dislocations, Strengthening mechanisms, Creep characteristics of creep curve & steady state creep. mechanisms & creep mechanism maps, creep under complex stress-states, prediction of long time properties, Fracture toughness & fatigue— Griffith's crack theory energy release rate analysis, modes of loading stress analysis of cracks fracture toughness, Low & high cycle fatigue, Fatigue crack initiation & propagation, Structural aspects of fatigue, fatigue under complex stress-states, environmental assisted cracking & fatigue, some case studies related to design, effect of stricture on strength, ductility & toughness, mechanical behaviour of metals, ceramics, polymers & composites.

Text Books and Reference:

1. Mechanical Metallurgy, G. E. Dieter (McGraw-Hill), 2017
2. Mechanical Behavior of Materials, Meyers & Chawala (Prentice Hall), 1998

Course Code: **MSE-S205T** **Breakup:** **3 – 1 – 0 – 3**

Course Name: **Materials Characterization –I**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding of identifying crystal structure
CO2	Understanding of surface properties by SEM and TEM
CO3	crystal structure and related properties
CO4	Surface Properties

CO5	X-ray Diffraction

Course Details

Chemical bonding, fundamentals of crystallography, reciprocal lattice, structures in metals, inorganic compounds, polymers, sib ates & glasses, stereographic projections X ray diffraction, diffraction theory' atomic scattering factor, integrated intensity of diffracted beams, temperature factor, line broadening. Techniques: Laue, powder & rotating crystal technique; for studying bent crystal, texture, order-disorder changes, elemental compound & alloy crystals, mode of bonding, crystal types, density of packing, atomic stacking, inter-atomic voids, coordination polyhdra, Paulings rules, symmetry elements, space & point groups, group theoretical formulation. Electron & neutron diffraction techniques; Optical principles of microscopy — resolution, magnification, depth of focus electron diffraction, imaging (various contrasts), determination of crystal structure, Burgers vector, electron-beam – specimen interactions & other applications of transmission electron microscopy, applications of scanning electron microscopy & electron probe microanalyser, Principles of quantitativ4e microscopy, volume density, surface density, length density, numerical density, particle & grain size.

Text Books and Reference:

1. Elements of X-Ray Diffraction, B. D. Culity (Addison Wesley), 1978
2. Physical Methods for Metal Characterization, Pej Flewitt (Institutue of Physics Pub.), 2003

Course Code: **MSE-S205P** **Breakup:** **0 – 0 – 3 – 2**

Course Name: **Materials Characterization Lab-I**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To learn about various experiments to verify certain properties
CO2	To learn about various experiments to verify certain laws

Course Details

Electrical, magnetic and dielectric properties of materials. Thermal characterization of materials.

Course Code: **MSE-S206** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Iron and Steel Making**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Describe the physical and chemical processes that take place during iron making and steelmaking at national level
CO2	Analyses the effect of change in process parameters in iron making and steelmaking processes
CO3	Describe the methods for control of quality in iron and steel production

Course Details

Refractories for iron & steel; design & profile of an iron blast furnace and its auxiliaries; performance

evaluation of blast furnace -iron ore reduction, fuel rate calculations, BF aerodynamics & hot metal quality control; physical chemistry of steel making & secondary steel making deoxidation; continuous casting of steel; vacuum degassing; sponge iron making.

Text Books and Reference:

1. Modern Iron Making , V. R. Tuppari, 2010, Khanna Pub.
2. Introduction to Modern Steel Making, V. R. Tuppari, 2000, Khanna Pub.

Course Code: **MSE-S301** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Fundamentals of Materials Processing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding of solidification processing for metals and alloys and modification of their properties as per the global development need.
CO2	Knowledge of metal deformation, working, forming processes and thin films etc.
CO3	Study of solidification processing for metals and alloys.
CO4	Study of Modification in properties of metals and alloys through solidification

Course Details

Overview of various processing methods for materials, Solidification processing, moulding methods, heat flow, microstructural evolution during solidification & effect of cooling rate on cast microstructures, micro macro segregation in alloys, directional solidification, rapid solidification, mold design, solidification shrinkage & riser design, fluid flow fundamental & metal fluidity, fundamentals of deformation processing -state of stress during various metal working operations, friction & its role in bulk metal forming operations , microstructural evolution during deformation processing, workability of metals, superplastic forming, metal flow & aspects of design during bulk forming operations, elementary load calculations during various bulk metal working operations Sheet metal forming state of stress during sheet metal forming processes, forming limit diagram, enhancement of sheet metal formability ,Thin films & coatings, growth of thin films from liquids, Physical vapour deposition (evaporation, sputtering), Chemical vapour deposition (thermal & plasma CVD)

Text Books and Reference:

1. The Science and Engineering of Materials, Donald R. Askeland (Chapman & Hall), 2010

Course Code: **MSE-S302** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Manufacturing Processes: Selection and Design**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To teach students to perform mathematical analyses of conventional and non-traditional manufacturing processes used at national level

CO2	To teach students to integrate core mechanical engineering principles to design manufacturing processes and systems

Course Details

Overview of manufacturing systems, Role of traditional & near-net shape processes in manufacturing industry, Basic attributes of manufactured products -size & shape complexity, machining requirement & machining losses, dimensional tolerance &, surface condition, mechanical properties & manufacture costs expendable mold & permanent mold shape casting processes, open die & closed die forging processes & design consideration, manufacturing process for making products such as sheets, round/sectioned bars, seamless tube /rings & wires, criteria for selection of metal & ceramic powder production processes for a given application, powder processing equipment & their selection. Joining processes, selection & design, case studies with CAD/CAM aspect.

Text Books and Reference:
1. Fundamentals of Manufacturing Processes, Lal & Choudhary (Narosa), 2014

Course Code: **MSE-S303** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Electronic and Optical Materials**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding about the semiconductors and its applications.
CO2	Understanding about the electronic properties of the semiconductors
CO3	Understanding about the optical properties oif the semiconductors
CO4	Formation of Semiconductor devices
CO5	Applications of Semiconductors.

Course Details

Electron dynamics and concept of holes, conductivity in relation to band structure, direct and indirect band gap, Degenerate and non-degene. ate semiconductor, lntrinsic and extrinsic semiconductor, application of semiconductor, DC and AC conductivity of metals, Hall effect and Magnetoresistance, Thermal conductivity and specific heat of material, thermo power of meals. Ionic conduction-review of defect equilibrium and diffusion mechanism, theory of ionic conduction, conduction in glasses, application in sensors and batteries, conducting polymers and organic semiconductors, piezoelectric materials, optical materials, electron-hole recombination, solid state LED's, Laser and IR-detector, band gap engineering, light interaction with materials—transparency, translucency, opacity, refraction and refractive index, reflection, absorption and transmission.

Course Code: **MSE-S304T** **Breakup:** **3 – 1 – 0 – 3**

Course Name: **Phase Transformation in Metals**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Characteristics of different phase transformation and how these characteristics can be controlled to design a desired microstructure.
CO2	Introduction and characteristics of different phases
CO3	Fundamentals of phase transformation
CO4	Understand the Crystal structures and deformation mechanism in various materials.
CO5	Study of basic principles to attain a desired microstructure.

Course Details

Thermodynamic order of transformations, theory of nucleation -kinetics of homogeneous, transient & heterogeneous nucleation, Theory of thermally activated growth, interface controlled growth diffusion controlled growth, interface instability & Widmanstatten growth, Eutectoid growth, Discontinuous precipitation, massive transformation, transformation kinetics: Johnson-Mehl equation, Avrami model, Transformation kinetics in diffusion controlled transformations, Isothermal & continuous cooling transformation diagrams, Precipitation & particle coarsening, Kinetics of recrystallization, theory of grain growth, Effect of second phase particles Solidiflcation- nature & growth of solid liquid interfaces rapid solidification, glass transition, metallic glasses.

Text Books and Reference:

1. Materials Science and Engineering, V. Raghvan, 2004, PHI
2. Phase Transformation in Metals and Alloys, D. A. Porter & K. E. Easterling, 2009, CRC

Course Code: **MSE-S304P** **Breakup:** **0 – 0 – 3 – 2**

Course Name: **Phase Transformation in Metals Lab**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To learn through experiments the characteristics of different phases
CO2	To learn through experiments Fundamentals of phase transformation

Course Details

Heat Treatment of Steels, Metallographic sample preparation to study phase changes

Course Code: **MSE-S305** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Heat Treatment of Metals**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Introduction of heat treatment operations
CO2	Fundametals of phase, phase transformation and stability of phases
CO3	Analyze various types of phase diagrams, TTT curve and Iron carbon diagram.
CO4	Understand about different heat treatment processes.
CO5	Study of basic principles to attain best combination of mechanical properties.

Course Details

Iron-carbon phase diagram, heat treatment of steel, hardenability of steels. TTT diagrams, CCT diagrams in steels, quench hardening & tempering of martensite Martensitic transformation nature of martensitic transformation, ham distortion, nucleation & growth of martensite, athermal, isothermal & burst transformations Spinodal decomposition Surface hardening processes, tool steels & their heat treatments, heat treatment of cast iron Thermochemical & thermo mechanical treatments Heat treatment of Ni-base superalloys & Ti alloys,

Text Books and Reference:

1. Physical Metallurgy, Lakhtin, 2005, CBS

Course Code: **MSE-S306** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Principles of Metal Extraction and Refining**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To learn through metal extraction processes applicable at national development
CO2	To learn through refining processes
CO3	To learn about extractive metallurgy of aluminum, copper and zinc

Course Details

Sources of raw material. Introduction of mineral dressing: Communication, tabling, jigging & flotation. Principles of pyrometallurgy – roasting, agglomeration, smelting, refining & secondary refining Principles of hydrometallurgy, electrometallurgy Extractive metallurgy of aluminum, copper and zinc

Text Books and Reference:

1. Principles of Extractive Metallurgy, H. S. Ray & A. Ghosh, 1991, New Age

Course Code: **MSE-S307T** **Breakup:** **3 – 1 – 0 – 3**

Course Name: **Principles of Powder Processing**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Differentiate manufacturing methods for the production of metal powders used globally
CO2	Discuss particle morphology: size, shape, characterization
CO3	Understand the requirements of lubricants and binders

Course Details

The particulate state- attributes & morphology of particles, distribution of particles in a single attribute, inspectation as a measure of global properties of particular ensembles, analysis of static & dynamic particulate systems by transformation attributes and measures, production of particles, particulates in suspension, stability, morphology and setting, size analysis, consolidation of powders, Sintering.

Text Books and Reference:

1. Powder Metallurgy, Erhard Klar (American Society of Metals), 1983
2. Introduction to Particulate Technology, Martin Rhodes (Jhon- Wiley), 2008
3. Powder Metallurgy Technology, G. S. Upadhayaya, 1998, Cambridge International Science

Course Code: **MSE-S307P** **Breakup:** **0 – 0 – 3 – 2**

Course Name: **Principles of Powder Processing Lab**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To learn through experiments the differentiate manufacturing methods for the production of metal powders
CO2	To learn through experiments the particle morphology: size, shape, characterization

Course Details

Powder Fabrication, Powder Characterization and Powder Processing.

Course Code: **MSE-S308** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Diffusion in Solids**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understanding of diffusion and its mechanism.
CO2	Study of diffusion processes in solid metals.
CO3	Study of diffusion processes in solid metals with various solutions of diffusion equations.
CO4	Knowledge of diffusion phenomenon in semiconductors, grain boundaries, surface, etc

Course Details

Diffusion equations and mathematical solutions Phenomenological diffusion theories Atomic theory of diffusion, theoretical and experimental investigation of diffusion in ionic solids and semiconductors Grain boundary and surface diffusion, thermal & electric-diffusion.

Text Books and Reference:

1. Diffusion in Solids, Paul G. Shewmon (McGraw Hill), 1963

Course Code: **MSE-S309** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Corrosion and Degradation of Materials**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To understand the degradation process of various engineering materials used

	globally
CO2	To understand electrochemical corrosion process To understand degradation of polymers and ceramics under physiochemical conditions
CO3	To understand degradation of polymers and ceramics under physiochemical conditions

Course Details

Thermodynamics and kinetics of materials corrosion., Oxidation, common forms of corrosion, stress corrosion, corrosion fatigue, radiation damages, corrosion effects, corrosion susceptibility tests, electrochemical measurements of corrosion rates, corrosion prevention and economic consideration, high temperature oxidation and sulphidation, corrosion case history, physical aging in polymers, degradation of polymers and their effect on mechanical properties

Text Books and Reference:

1. Corrosion, M. G. Fontana, 1978, McGraw-Hill

Course Code: **MSE-S310** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Materials Characterization – II**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Characterization techniques to analyze the Sturtual Properties
CO2	Characterization techniques to analyze the Surface Properties
CO3	Characterization techniques to analyze the Thermal Properties
CO4	Characterization techniques to analyze the Optical Properties
CO5	Characterization techniques to analyze the Magneticl Properties

Course Details

Thermal analysis tools, Thermometry and dilatomentrt, calorimetry, differential scanning calorimetry (DSC), DTA, Temperature modulates alorimetry, Thermomechanical analysis, DMA and DETA, Therrnogravimetry, X-ray fluorescence, photoluminescence, UV photoelectron spectroscopy, Fourier transform JR spectroscopy, Laser Raman spectroscopy, photoelectron spectroscopy, Auger electron spectroscopy, secondary ion mass spectroscopy, electron energy loss spectioscopy, solid state NMR, scanning tunneling microscopy, atomic force microscopy, Rutherford bac1 scattering spectroscopy, Particles induced x-ray emission, neutron activation analysis, Mossbauer spectroscopy, positron annihilation spectroscopy.

Course Code: HSS – S301 **Breakup: 1 – 1 – 1 – 2**

Course Name: Professional Communication
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the nuances of English language for enhancing presentation skills
CO2	Speak in standard English with clarity and fluency and to write business messages professionally
CO3	Speak and communicate clearly in different professional contexts which would improve their chances of employability
CO4	Understand the importance of ethical practices in their professional life

Course Details

Unit 1- Presentation Techniques

- Meaning and importance of presentation technique
- Use of presentation techniques in everyday life
- Presentation skills required for business organization
- Types of business presentations-meetings, seminars, Conferences

Unit 2-Oral presentations

- Effective oral presentation techniques
- Tips for good oral delivery; debates, elocution, impromptu speeches
- Levels and models of organizational Communication
- Interviews-types of interviews
- Group discussions

Unit 3- Written communication

- Style and tone of writing business messages and Documents.
- Writing for websites, internet e-mails and short messages
- Applications, letters, memos
- Proposals and report writing

Unit 4 - Nonverbal presentations

- Nonverbal communication techniques
- Business manners, ethics and personality development
- Audio/visual presentations, power point presentations
- Art of delivery

Unit 5- Literary concepts

- Stories, essays, comprehension
- Reading techniques-skimming and scanning methods
- Listening skills

Text Books and Reference:

1. "Business Communication Today", Bove'e, Thill and Schatzman: Pearson Education(Singapore),2003

2. "Business Communication-a framework of success", H.Dan O'Hair, James S.O'Rourke and Mary John O' Hair: South Western College Publishing 2001.
3. "Basic Business Communication", Raymond V.Lesikar, Marie E.Flatley: Tata McGraw Hill Publishing Company Ltd., 2002.

Course Code: **HSS-S401** **Breakup:** **3 – 1 – 0 – 4**

Course Name: **Industrial Economics**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	provide students with the analytical skills required for understanding problems in national industrial interest
CO2	examine the key questions on the internal organisation of firms
CO3	analyse various aspects of strategic interaction between firms and the determinants of industrial structure.
CO4	provide students with the ability to apply economic models of firm behaviour to analyse questions in business strategy, competition policy and regulation.

Course Details

Unit -I
Definition and scope of engineering economics
Concept of supply and demand
Price elasticity and cross elasticity of demand
Production
Engineering costs and cost estimation
Concept of time value of money
Cash flow analysis

Unit-II
Perfect competition
Monopoly
Monopolistic competition

Unit-III
National Income, GDP
Inflation, Deflation and treatment

Unit-IV
Functions of RBI
Indian Tax System

Text Books and Reference:

1. Henderson, M. James and Quandt, E. Richards, "Microeconomic Theory: A Mathematical Approach".

2. Koutsoyiannis, A., “Modern micro economics”.ardwick, Philip., Khan Bahadure., Langmeed, John, “An Introduction to modern economics”.
3. Samuelson, A. Paul, “Economics”.
4. Shapiro, Edward. “Macro economics”.
5. Newnan, G. Donald, Eschenbach, G.Ted, Lavelle, P. Jerome, “Engineering Economic Analysis”.

Course Code: **MSE-S401** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Composite Materials**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Explain the mechanical behaviour of layered composites compared to isotropic materials.
CO2	Apply constitutive equations of composite materials and understand mechanical behaviour at micro and macro levels
CO3	Determine stresses and strains relation in composites materials used locally

Course Details

Classification of composite materials, dispersion strengthened, particle reinforced and fiber reinforced composite laminates properties of matrix and reinforcement materials. Micromchenics and principles of strengthening, elastic properties, stress-strain relations, fracture behaviour, fabrication methods and structural applications of different types of composite materials.

Text Books and Reference:

1. Composite Materials: Science & Engineering, K. K. Chawla (springer), 1987

Course Code: **MSE-S404** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Electronic Materials for Industry**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the quantum mechanics of electron in crystals.
CO2	Understand the basic electrical and magnetic properties of crystalline solids and amorphous materials used in national industries
CO3	Understand the difference between electronic structures and physical properties of semiconductors, metals, and dielectrics.
CO4	Understand the physics of magnetic phase transitions and superconductivity.
CO5	Measure and analyze transport characteristics of semiconductors.

Course Details

Dielectric Materials-dielectric constant and polarization, polarization mechanism, linear and nonline dielectric, pyro-piezo,and ferroelectric properties, application magnetization-diamagnctisn paramagnelism, polypararnagnetism, ferro, antiferro, and ferri magntism. Soft and hard magnet materials, permanent

magnet and transformers. Carrier statistics in semiconductor, semiconductor materials purification, and crystals growth, epitaxy, CVD and, MBE, Physical vapor deposition (sputtering, evaporation, etc), P-N junction, Schottky & MaS device structures, doping by implantaik and diffusion, ion implantation, patterning, etchlithography, empirical rule, alloy design, very large sea integration (VLSI).

Text Books and Reference:

1. Elements of Materials Science and Engineering, L. H. Van Vlack (Addison-Wesley), 1985
2. Materials Science and Engineering: An Introduction, W. D. Callister, (WILEY), 2006
3. The Science and Engineering of Materials, Donald R. Askeland (Chapman & Hall), 2010
4. Solid State electronic Devices, B.G. Streetman (PHI), 2005

Course Code: **MSE-S405** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Heat and Mass Transfer**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Explain the basic modes and laws of heat transfer.
CO2	Analyze general heat transfer equations
CO3	Basics of heat transfer by conduction, convection and radiation.
CO4	Fundamentals of conduction in solids for solid state conditions, heat transfer by convection
CO5	Heat transfer by thermal radiation and convective mass transfer.

Course Details

Review of basic concepts in heat, mass and momentum transfer, advanced topics in convective heat transfer, radiative heat transmission, simultaneous heat and mass transfer, selected topics in materials processing.

Text Books and Reference:

1. Kinetics of Metallurgical Reactions, Hem Shanker Ray (Oxford & IBH), 1993
2. Heat & Mass Transfer, H. S. Ray, 1995

Course Code: **MSE-S406** **Breakup: 3 – 1 – 0 –4**

Course Name: Computing Methods in Materials Engineering

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	an ability to apply knowledge of mathematics, science, and engineering to problems in materials engineering.
CO2	an ability to identify, formulate, and solve engineering problems, particularly in the context of materials selection and design.

CO3	an ability to exhibit effective oral and written communication skills.
CO4	11. an ability to use the techniques, skills, and experimental, computational and data analysis tools necessary for materials engineering practice.

Course Details

Introduction to programming language, differentiation, integration, finding roots of equation and solving linear algebraic equations, Interpolation, extrapolation, application of regression analysis and curve fitting techniques, computer calculation of phase diagrams, numerical solution of partial differential equation pertinent to heat, mass and momentum transfer, computer application in solidification, potential energy diagrams, mass balancing, data reconciliation problem solving with material balance software package quantitative description of mineral processing units and its computer implementation, introduction to a general purpose modular, simulation for process analysis.

Departmental Elective Courses

Course Code: MSE-S501 **Breakup: 3 – 1 – 0 –4**

Course Name: Electrochemical Technology in Materials Processing

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To provide the basic physical concepts required to understand energy storage technology
CO2	To help the students to explore the materials used in various components of electrochemical energy systems
CO3	To discuss the performance characteristics and characterization methods of battery/supercapacitors/fuel cells
CO4	The students will understand the materials , fabrication, operation and analysis of electrochemical energy storage systems

Course Details

Thermodynamics of electrolyte, electrochemical potential, conduction of ions in solution, over potential. absorption, phase formation, economics of an electrolyte process, principles of cell design. electrochemical technology, electrowinning, electrorefining, metal electro forming Electrochemical machining, electroplating, anodizing, pickling, electrophoretic painting. Electrochemical treatment of minerals, batteries and cells, water treatment and environmental protection.

Course Code: MSE- S502 **Breakup: 3 – 1 – 0 –4**

Course Name: Application of Transport Phenomenon in metal processing

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Basics of momentum transport: Euler/Lagrangian viewpoint, laminar and turbulent flows, boundary layers, stress tenso
CO2	Basics of energy transport, conductive, convective & viscous dissipation energy fluxes

Course Details

Review of heat, mass and momentum transfer, fundamentals of turbulence phenomena, turbuleny flows. dimensional analysis and reactor design, free convection phenomena and bubble/gas driven systems, applications of transport phenomena to (I) gas stirred ladle system (2) desulphurization of

pig iron using Mg vapour (3) alloy addition kinetics (4) soaking & soaking furnaces.

Course Code: **MSE-S503** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Engineering Polymers**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Students will understand and appreciate the importance of the polymers as an important class of materials
CO2	Students will be well equipped to study the advanced courses related to polymer science and technology included in the curriculum
CO3	To make them aware the structure property relations of polymers

Course Details

Classification & structure of polymers, polymer synthesis, copolymers,' Molecular structures & architecture, molecular weight distribution, rotational' isomeric states, chain configuration in dilute solution & condensed states, characterization of molecular weight & distribution, light scattering, Osmometry, Intrinsic viscositye1 permeation chromatography, solidification, glass formation, glass, spherulites, alloys, multicomponent metals, processing effects thermal effects of rheological behaviour, Time tempeure equivalence, WLF equation, Arrhenius behaiour, Mechanical behavior of solids, Viscoelasticity, Boltzmann superposition principle, failure behavior & criteria Glass transition, liner viscoelasticity, stress relaxation and dynamic experiment mechanical morals, superposition principle effect or structure on mechanical properties, rubber is elasticity, yield & fracture polymer working process such a extrusion, forming shaping injection molding, blow molding, sheet forming, film forming, thermoforming and callendering, advances in polymer working technology, effect of processes in structure and properties, material selection & design consideration.

Course Code: **MSE-S505** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Ceramic Materials**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Knowledge of crystal structure of ceramics.
CO2	Knowledge of structure-property relationship in ceramics.
CO3	Knowledge of the defects in ceramics (Point defects).
CO4	Knowledge of glass and glass-ceramic composite materials.
CO5	Introductory knowledge on the processing of bulk ceramics

Course Details

Crystal chemistry — structure and bonding in materials, ceramic raw materials, production of powders by chemical and physical mean, powder consolidation, addition in ceramic processing,

sintering and sintering theory, cold and hot isostatic pressing, processing of electronic ceramic, sol-gel processing.

Text Books and Reference:

1. Fundamentals of Ceramics-Barsoum:
   Publication Year: First published in 1997 by McGraw-Hill
2. Introduction to Ceramics: W. D. Kingery, H. K. Bowen, D. R. Uhlmann and R. Frieser :
   Publication Year:1977 ECS - The Electrochemical Society

Course Code: **MSE-S506** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Materials Engineering**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
CO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
CO3	an ability to communicate effectively with a range of audiences
CO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
CO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Course Details

Crystal growth, Heat treatment, Nondestructive evolution, Processing of glasses and polymers, Novel processing methods, Thin films, Materials selection for different engineering applications.

Course Code: **MSE-S507** **Breakup:** **3 – 1 – 0 –4**

Course Name: **Modern Steel Making and Alloying**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basics of metallurgy involved in iron and steel making as per global development need.
CO2	Describe the overview of processing of iron and steel.

Course Details

Alloy steel making processes – special reference to stainless steel, high speed steel, manganese steel other special steels. Thermodynamics and kinetics of alloy steel making. Defects and remedies. Post solidification treatments. Secondary alloy steel making technologies. Problems.
Overview of Indian ferro alloy sector and alloy steel sector. Basics of ferro alloys production – concept: thermodynamic principles and techniques. Existing production processes of important ferro alloys, Fe–Cr, Fe–Mn, Fe–Si. Recent advances in ferro alloy technology. Production of other ferro alloys – Fe–V, Fe–Ti, Fe–W, Fe–Ni, Fe–Mo, Fe–Zr, Fe–B, etc.